PENNICHUCK BROOK URBAN RUNOFF MONITORING PROGRAM

NASHUA REGIONAL PLANNING COMMISSION

February, 2000

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A 3 Distribution List

1. Gary Tetly (Lab Manager), Matt Day, and Bernard Rousseau of Pennichuck Water Works
2. Betsy Hahn and Julie Cummings, Project Managers, Nashua Regional Planning Commission
3. Eric Williams, Project QA Officer, New Hampshire Department of Environmental Services
4. Warren Howard, Project Manager, US Environmental Protection Agency

A 4 Project/Task Organization

The Pennichuck Brook Urban Runoff Project requires the participation of a number of partners. The two major partners are Pennichuck Water Works and the Nashua Regional Planning Commission. Pennichuck Water Works will be responsible for the design, construction and inspection of the stormwater treatment system, the water quality monitoring components of the project and long-term maintenance of the stormwater treatment system. Gary Tetly is the Pennichuck Lab Manager (603-598-5331) and has the overall responsibility for sampling and contact with Chemserve Lab. The NRPC (603-883-0366) will be responsible for the educational component, assistance with the final report, and information coordination with Eric Williams (603-271-2358), the NHDES Project QA Officer. Eric Williams is responsible for coordination with the USEPA Project Manager Warren Howard. Since the stormwater treatment system is located on the NH Technical College campus and the NH DOT holds an easement on part of the land, both the state educational system and the NH DOT are involved in the project. The design of the stormwater treatment system was coordinated with the NH DOT; however, these two organizations are not involved with water quality monitoring.

A 5 Problem Definition/Background

The Pennichuck Brook system is the major water supply source for the Nashua region and serves as Pennichuck Water Works primary source of water (approximately 75 percent). Portions of the Pennichuck Brook watershed are impacted by urban runoff from industrial, commercial and high density residential uses as well as the region's major transportation networks, the FE Everett Turnpike and NH Route 101A. This project deals with the impacts of urban runoff on the Pennichuck Brook system and includes both the construction of structural measures and educational efforts to reduce the impacts of nonpoint source pollution on the region's most important public water supply source.

The drainage area (see Sheet 1) contains such varied uses as car washes, gas stations, automobile oil and lubrication services, automobile muffler and brake services, dry cleaners, restaurants and retail establishments. The threat of an accidental spill contaminating the Pennichuck Brook system is very real. In December of 1994, an accidental oil spill at the Greased Lightning facility leaked into a floor drain, which was connected to a storm drain, and was discharged to the Holt Pond tributary at the outfall behind the NH Technical College. Given the types of businesses within the drainage area and within the greater watershed, increasing awareness of the potential negative impact of business or individual actions on the public drinking water supply is an important aspect of the project. Information and educational tools developed for this project can be utilized throughout the Pennichuck Brook watershed and can also be transferred to other communities.

The closed drainage system and direct stormwater discharge to a tributary of Holt Pond have a negative impact on water quality in the Pennichuck Brook system. Stormwater runoff containing sediments, nutrients, petroleum hydrocarbons, bacteria and metals is directly discharged to the

tributary via a 48 inch pipe with no treatment The drainage area of the outfall is approximately 79 acres with an estimated impervious coverage of 60 percent. Fifty-two catch basins collect stormwater runoff from the streets, residential neighborhoods and parking lots of the roughly 60 businesses in the drainage area. Although no water quality monitoring has taken place, the type of samples collected was based on current land uses.

A 6 Project/Task Description

The goal of the Pennichuck Brook Urban Stormwater Project is to decrease the impacts of urban runoff on the Holt Brook tributary and this Pennichuck Brook sub-watershed. The Holt Pond sub-watershed area is a highly urbanized section in the entire watershed and is approximately 2,390 acres. The actual water entering the treatment systems drains 79 acres or approximately 3 percent of the sub-watershed. This particular system was chosen to demonstrate the effectiveness of low technology urban runoff management practices on water resources. Achieving these goals will involve: diverting the untreated discharge through a multi-cell stormwater treatment system (completed in 1998); educating the businesses in the drainage area on the negative impacts of NPS and accidental spills on the city's public water supply; increasing public awareness of the link between the stormwater drainage system and the public drinking water supply through a storm drain stenciling program; and encouraging local planning boards and other communities to incorporate urban runoff best management practices in the designs of future development in the communities.

Eleven parameters were chosen for this project based on the drinking water standards and the following rationale:

1. E. coli -To determine if this is a problem and hopefully correct this at the source.
2. Temperature – To be used as a contributing factor with other parameters i.e. phosphorous and increased algal blooms.
3. Nitrates – Athletic fields at the NH Technical College and landscaping in the drainage area.
4. Petroleum Hydrocarbons – There is approximately 60 % impervious surface area and a wide variety of industrial businesses.
5. TKN -
6. Total Suspended Solids – Holt Pond receives large volumes of urban runoff from parking lots and other impervious surfaces in the watershed.
7. Total Phosphorous – Used on athletic fields and neighborhood landscaping. It is the limiting nutrient which algae utilize to maintain their growth and reproduction.
8. Mercury – Known increase and health warning on the consumption of fish.
9. RCRA Metals – Wide variety of industrial type businesses.
10. Ammonia - Wide variety of industrial type businesses.
11. Dissolved Oxygen – Good indicator of problems/water quality with other parameters.

Project Schedule

The project will proceed on the following schedule:

1. Develop QAPP – August 1999
2. Train Volunteers – September 1999
3. Revise QAPP – January 2000

3. Sampling – Five during 2000, Five in 2001
4. Analyze monitoring and write report – June 2000. Based on what we have taken in the spring of 2000.

A 7 Acceptance Criteria

Parameters and Method	Desired Precision	Accuracy	Maximum Acceptable Blanks	Method Detection Limit	"Known" Limits
E. coli-9213D SM 20th Edition	Re-analyze 10% of all positive samples	All pos. hits must be recounted by a second analyst	0 colonies/100ml	0 colonies/100ml	
DO and Temperature YSI Model 55	Manuf. Spec. 0.1mg/l with +/- 0.1% acc.	Manuf. Spec. 0.1mg/l with +/- 0.1% acc.	NA	0mg/L	NA
Nitrates-EPA 300.0 revised 2.1 Aug. 1993	%RPD≤25%	Blank spike every batch 80-120% MS/MSD every 20 samples 80-120%	<1.0 mg/L	1.0 mg/L	
Ammonia-EPA 350.2	MS/MSD pairs-every on batch % RPD<25%	MS/MSD pairs-every on batch % RPD<25% 80-120%	<0.1 mg/L	0.1 mg/L	Limits spec. by manuf.
Petroleum Hydrocarbons SW 8100			<100ug/L	100ug/L	NA
TKN-EPA 351.3	MS/MSD pair every 20 samples or batch 80-120%	MS/MSD pair every 20 samples or batch 80-120%	<0.1 mg/L	0.1 mg/L	Limits spec. by manuf.
Total Phosphorous-EPA 365.2	NA	Every 20 samples or batch 80-120%	<0.05mg/L	0.05mg/L	Limits spec. by manuf.
RCRA Metals-6010 B, SW 846 rev. 12/96	10% of sample <20%RPD	MS-10% of samples 70-130% Blank spike 85-115	<DLN <10% of sample value	See attached	NA
Total Suspended Solids-EPA 160.2 rev. 1971	1 every 20 samples	NA	<4mg/L	4mg/L	Limits spec. by manuf.

SW – Solid Waste SM-Standard Methods RPD-Relative Percent Deviation MS-Matrix Spike
MSD-Matrix Spike Duplicate

B 2 Sampling Procedures

Water Quality Monitoring: Wet weather water quality monitoring will be conducted on stormwater entering and leaving the multi-cell stormwater treatment system during rain events that are preceded by 72 hours of dry weather and are predicted to have at least 0.3 inches of rainfall. Four sampling stations will be located throughout the multiple treatment cells as described below and indicated on Sheet II:

Station #1 – Outlet of storm drain from Amherst Street and the beginning of the sedimentation bay.
Station #2 – End of the sedimentation bay and the beginning of the marsh area.
Station #3 – End of the marsh area and the beginning of the wet pond.
Station #4 – End of the wet pond near the bar rack.
Samples will not be collected if the hold time can not be met or if the lab is closed. A record will be kept documenting the following:

1. Date the rainfall event started
2. Time the rainfall event started
3. Time the rainfall event ended
4. Total amount of the rainfall event in inches
5. Previous rainfall event date and the amount
6. Flows at the time of sampling

SAMPLE COLLECTION PROCEDURE

1.0 The chain of custody and sample bottles are prepared and provided by Chemserve Laboratory. Upon receiving the cooler the sampling agent will inspect each bottle for the appropriate size, container material (glass or plastic), and preservative. There should be two sets of these bottles for station 1 and one set for each of the three remaining stations. Each bottle will be labeled by Chemserve with the preservative used and the test(s) to be performed. The sampling agent will check this information carefully before going into the field.

2.0 Pennichuck Water Works personnel will perform the Dissolved Oxygen (DO) and temperature measurements in the field using at YSI Model 55 DO meter. It will be calibrated in the field before sampling begins using the manufacturer's instructions. Readings will be recorded in a field notebook with date, time, and initials of sampler.

3.0 Station number one is an open pipe spilling into the first detention pond. Each sample bottle will be opened and filled to the shoulder of each bottle. The sample bottle used to collect the bacteria sample should contain at least 100 mL and care should be taken not to touch the inside of the bottle or allow the inside of the cap to touch any surface. Once filled the bottles will be placed in the cooler. Record date, time, and initials on chain of custody form. DO and temperature measurements will be taken by inserting the DO probe into the sample stream and recording the mg/L level of dissolved oxygen and the temperature in degrees centigrade. Be careful to not overflow bottles with preservative or touch the inside of the sampling container used for collection of bacteria sample.

4.0 Stations two through four will have to be sampled by submerging each bottle under the water at least several inches to avoid collecting surface debris otherwise follow instructions in step 3.0.

5.0 Field duplicates will be taken at least once for each parameter during each sampling event.

6.0 Once all samples have been collected and the appropriate paperwork has been filled out completely the sample are to be taken immediately to the Chemserve Laboratory in Milford, NH. The trip should take no more than 30 minutes.

7.0 Samples and paperwork will be turned over the sample receptionist at Chemserve. Arrangements will be made at this time to receive a complete replacement set of bottles for next sampling event.

Calculating Flow

To estimate the impact of the contaminant contributions, measurements will be made to determine the stormwater flows at the time of sampling, and ultimately the loading rates. Since the water is hard-piped, the following equation will be used to estimate flow: Q=VA. Where Q equals the flow in cubic feet per second (cfs), V equals the velocity in feet per second (fps), and A equals the cross sectional area of water in the pipes in square feet (sf).

The cross sectional area of water in the pipe will be determined by measuring the depth of flow in the pipe. Knowing the depth of water and the diameter of the pipe, the cross sectional area will be determined using geometric relationships. The velocity of flow will be estimated by counting how many seconds it takes for a floating object to travel a known distance. These measurements will give an approximation of the flow.

B 3 Chain of Custody

Gary Tetly, Matt Day and Bernard Rousseau have been trained to collect the samples in accordance with the Standard Methods standard operating procedures for the collection of samples (Section 1060B, 18th Edition). A chain-of-custody form provided by Chemserve will be filled out each time a sample is collected with the following information:

1. Sample station number, sample identification and location
2. Date and time the sample was collected
3. Sample type: Grab
4. Sample matrix: Water
5. Number of containers turned into the lab
6. Preservative used in each container
7. The analysis requested
8. Sampler name and signature
9. Date and time the samples were dropped off at the lab

Sample collection by Pennichuck Water Works will include the following: E. coli, nitrates, ammonia, petroleum hydrocarbons, TKN, total suspended solids, phosphorous, mercury, and RCRA regulated metals. Pennichuck will measure DO and temperature in the field with a DO meter and duplicate measurements will be made and recorded. Monitoring will be conducted to

assess the effectiveness of pollutant removal. Chemserve Laboratory in Milford, NH will analyze all samples according to accepted QA/QC standards. A total of ten sampling runs will be analyzed.

Field Sampling Table

Parameter	Sample Matrix	# Samples	Sample Volume	Sample Container	Preserve. Method	Max. Holding Time
E. coli	Water	50	250 mL	Sterilized container	4 deg. C	6 hrs.
Temperature/DO	Water	50	NA	NA	NA	NA
Nitrates	water	50	500mL	Plastic	4 deg. C	48 hrs.
Petroleum Hydrocarbons	Water	50	1000 mL	Wide mouth brown jar	4 deg. C Hydrochloric acid	28 days
TKN	Water	50	1000mL	Plastic	4 deg. C Sulfuric acid	28 days
Total Suspended Solids	Water	50	500 mL	Plastic	4 deg. C	7 days
Total Phosphorous	Water	50	1000 mL	Dark plastic	4 deg. C Sulfuric acid	28 days
Mercury	Water	50	500 mL	Plastic	4 $\pm$ 2 deg. C HNO3 pH< 2	28 days
RCRA Metals	Water	50	500 mL	Plastic	4 deg. C$\pm$ 2 Nitric acid	Six months
Ammonia	Water	50	1000 mL	Plastic	4 deg. C Sulfuric acid	28 days

B 4 Analytical Procedures

Analytic	Matrix	Analytical Method
E. coli	Water	9213D SM 20th Edition
DO/Temperature	Water	DO meter YSI Model 55
Nitrates	Water	EPA 300.0 revised 2.1 Aug. 1993
Ammonia	Water	EPA 350.2
Petroleum Hydrocarbons	Water	EPA 8100
TKN	Water	EPA 351.3
Phosphorous	Water	EPA 365.2
Arsenic	Water	6010 B SW846 6010B revised 12/96
Lead	Water	6010 B SW846 6010B revised 12/96
Barium	Water	6010 B SW846 6010B revised 12/96
Mercury	Water	EPA 245.1 revised 3 May 94
Cadmium	Water	6010 B SW846 6010B revised 12/96
Selenium	Water	6010 B SW846 6010B revised 12/96
Chromium	Water	6010 B SW846 6010B revised 12/96
Silver	Water	6010 B SW846 6010B revised 12/96
Total Suspended Solids	Water	EPA 160.2 revised 1971

B 5 Quality Control Samples

Analyses	Lab Duplicates	Spiked Samples	Trip Blanks	Lab Blanks
E. coli	5-10%		10%	
DO/Temperature	NA	NA	NA	NA
Nitrates	7	Every 20 samples	10%	Every 20 samples
Ammonia	5-10%	Every 20 samples	10%	Every 20 samples
Petroleum Hydrocarbons	10%		10%	
TKN	Every 20 samples	Every 20 samples	10%	Every 20 samples
Phosphorous	5-10%	Every 20 samples	10%	Every 20 samples
Arsenic	10%	5-10%	10%	Every 20 samples
Lead	10%	5-10%	10%	Every 20 samples
Barium	10 %	5-10 %	10%	Every 20 samples
Mercury	10%	5-10%	10%	Every 20 samples
Cadmium	10%	5-10%	10%	Every 20 samples
Selenium	10%	5-10%	10%	Every 20 samples
Chromium	10%	5-10%	10%	Every 20 samples
Silver	10%	5-10%	10%	Every 20 samples
Total Suspended Solids	Every 20 samples		ERA or equiv.	Every 20 samples

D 1 Data Quality Requirements

Data Representatives: Samples and field data will be collected from the four sampling stations. These sampling stations will accurately represent the water quality of stormwater discharges into the Holt Brook tributary. Duplicate samples will be collected at a rate of approximately 10 percent of the samples collected to ensure the integrity of the data. There are a total of 10 scheduled wet weather sampling events Samples and data will be collected following Standard Methods standard operating procedures for the collection of samples (Section 1060B, 18th Edition). All volunteers will be trained in standard methods of sample collection and procedures and protocols.

Documentation, Data Reduction and Reporting: Chain-of-custody documentation will be maintained. Data sheets will be reviewed for completeness, Standard Analytical Methods, preservatives and for holding times by the Project QA Officer.

Corrective Action: When it is found that the data is incomplete or that the results are unacceptable, the Project may determine that one or more of the following procedures for corrective action shall be undertaken.

1. Incomplete data – Omissions from logs, notebooks and worksheets place the entire analysis in question. Incomplete sampling may require resampling during another storm event. Incomplete lab data usually calls for reintroduction or reanalysis of the questionable sample if possible.

2. Conflicting data – Conflicting data may require the entire analytical performance be questioned. For example if higher concentrations are found at station 4 than station 1. Theoretically, concentrations should be decreasing as they are absorbed or settle out through the treatment cells. Other supportive documentation may aid in resolving problems. When this is not available, the Project Officer may require resampling during another storm event or reanalysis if possible.

3. Poor performance – When resulted from duplicates fall outside of the acceptable ranges, the Project Officer will review the available data and discuss the problem with Chemserve and the

Pennichuck Lab Manager. The final decisions on data review and acceptance rest with the Project Officer. Upon examination, all or some for the following actions may be applied:

A. System audit for analyte in question (Chemserve).
B. Determination of matrix interference.
C. Reconsideration of acceptable limits with statements included explaining the action/rationale taken.
D. Rejection of data and exclusion from the report with a written explanation.
E. Rejection of the entire sample/site location with recommendation of relocation of sample site or reconsideration of results sought.

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